

NRC Staff Views on the Bioshield Wall Major Penetrations Shielding, and the Reactor Building Nuclear Power Module Ventilation System Fire Damper Controls, or Ventilation Duct Radiation Source Term Description, for Discussion at July 22, 2019, Public Phone Call

The NRC staff and NuScale have a common goal of completing the phase IV design review this fall, and a common goal of NuScale completing proposed changes to the FSAR by the end of July. For NRC and NuScale to reach those goals on the desired timelines, the NRC staff recognizes the need to provide mutually advantageous solutions to identified problems that will allow NuScale to be able to address the staff's concerns without developing additional calculation packages, and without performing additional design work. Alignment between NuScale and the NRC on the implementation of interface requirements regarding identified areas that have not yet been fully designed would provide a timely and efficient solution that would allow the staff to complete its evaluation of those areas, while meeting the mutual goals discussed above. As such, the staff has identified what it believes is a workable path forward on three RAIs (below) associated with needed design implementation interface requirements (RAI-9295 Question 12.03-55, RAI-9656 Question 12.03-63 and RAI-9278 Question 12.03-33). These RAIs pertain to radiation shielding associated with the penetrations in the shield wall and the use of fire dampers to isolate ventilation ducts for the purpose of confining radioactive materials.

Per NuScale's request, the staff would like to offer additional information about interface requirements used in a previously certified standard design. Specifically, the ESBWR design provides an acceptable example of implementing interface requirements. The ESBWR design implemented interface requirements by making changes to the ESBWR Design Control Document Tier 1 Chapter 4, (ML14100A493). One possible success path that the NRC has identified for the RAIs above is the implementation of changes to the NuScale DCD Tier 1 "Certified Design Descriptions and Inspections, Tests, Analyses, & Acceptance Criteria (ITAAC)," Chapter 4 "Interface Requirement," based on those described below.

NuScale's response to RAI-9295 Question 12.03-55 dated 8 May 2018 (ADAMS Accession No. ML18128A390), stated:

- FSAR Tier 2 Figures 3.6-16 and 3.6-17 are labeled as "Postulated" and "COL applicant scope" because the actual pipe routing and penetration shielding has not yet been finalized and has been identified as COLA scope.
- FSAR Tier 2 Section 12.3.1.2.3 Penetrations and FSAR Section 12.3.2.2 Design Considerations, state that shield wall penetrations may be configured and shielded, as necessary, to prevent excessive radiation streaming into accessible spaces.
- The details of the NuScale penetrations and penetration shielding design are not finalized but will be finalized during a future design phase. The NuScale design is not unique in this respect and the detailed design of shield wall penetration compensatory measures will utilize standard industry practices to ensure the design complies with the FSAR.
- That the portion of the shielding referenced within RAI 9295 was the responsibility of the COL Applicant and will be finalized during a future design phase.

NuScale's response to RAI-9656 Question 12.03-63 dated May 15, 2019 (ML19137A287), stated in part that the detailed design for pipe routing and penetration shielding has not been completed, and that the COL applicant will complete the detailed design, and construct and operate the facility as described in the DCA. NuScale further stated that Section 12.3.1.2.3 "Penetrations" has been revised to link the radiation zone maps to penetration shielding design. NuScale also stated that COL Item 12.3-8 had been revised to include other major shield wall penetrations, and to identify the associated DCA sections that provide the compensatory shielding design descriptions.

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During subsequent conversations with NuScale, the staff further discussed some of the relative aspects of the approach NuScale is proposing (a COL Item) versus the staff request for an Interface Requirement. During these conversations, NuScale asked the staff for additional information regarding the method for implementing the Interface Requirement (see above for the ESBWR example).

The NRC staff observes that a COL item can adequately address a matter outside of the scope of the standard design that does not have the potential to affect portions of the design resolved in the design certification rulemaking. If resolution of a matter outside the scope of the standard design can affect the basis for the NRC staff conclusions on the adequacy of the standard design, which the NRC staff believes is the case for the two design matters discussed above, then some other method of controlling that matter is necessary.

Overall, the NRC staff proposes the use of interface requirements to help move this review forward in an effective and efficient manner. Specifically, there are two separate interface requirement items under consideration by the staff: (1) bioshield penetration radiation shielding, and (2) design of controls for RBVS HVAC NPM isolation dampers, and treatment of potential dose from RBVS HVAC ducts. The staff suggests that NuScale include two separate Interface Requirement entries in FSAR Tier 1 "Certified Design Descriptions and Inspections, Tests, Analyses, & Acceptance Criteria (ITAAC)," Chapter 4 "Interface Requirement," similar to what was done in ESBWR DCD Tier 1 Chapter 4.

The staff suggests that each of the new interface requirements would have two subsections: 1) Design Description and 2) Interface Requirements. The following examples follow the form of the ESBWR interface material and are provided to help NuScale understand the types of information that the NRC staff is seeking. NuScale should develop the specific text of the interface requirements.

**4.2 Bioshield Penetration Radiation Shielding
Design Description**

This description should be sufficiently detailed to describe that radiation shielding is provided for bioshield penetrations to perform the following three functions. First, the shielding should protect equipment important to safety, consistent with GDC 4, 10 CFR 50.49, and survivability considerations. Second, and the shielding should limit radiation exposure to members of the public (the NPM bioshield penetrations are directly across from exterior wall penetrations), consistent with GDC 61 and Part 20, Subpart D. And third, the shielding should limit occupational dose to workers during normal operation and during and following accidents, consistent with GDC 61 and Part 20, Subpart C. This section should have a statement to the effect that the details of the NuScale penetrations and penetration shielding design are not yet final (i.e., not within the scope of the certified design) but will be finalized during a future design phase. This section should also indicate that the plant-specific portion of the bioshield wall penetration radiation shielding will meet the interface requirements defined below.

Interface Requirements:

This section should identify that the radiation shielding is for the Major Penetrations of the NPM Bioshield Wall, such as the Main Steam lines, the Main Feed Water lines, and the NPM HVAC ventilation system ducts. The description should also describe the target dose rates for each of the shielding functions, including during 1) normal operation

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(combined neutron and gamma), 2) design basis accidents (gamma), and 3) beyond design basis accidents (gamma), for the dose rates that were used in the standard design as the basis for equipment qualification, equipment survivability, post-accident public dose assessments, and post-accident mission dose assessments.

This section should include a discussion of the method to be used for the verification of compliance with the interface requirements.

4.3 Reactor Building NPM Bay Ventilation System Design Description

This description should be sufficiently detailed to describe that the RBVS HVAC system design assumptions include elements (e.g., fire dampers and the associated controls) for limiting the spread of radioactive material out of the RXB pool area and NPM bays during design basis events and during beyond design basis events. The design of the RBVS HVAC should address the following functions. First, the RBVS HVAC design should protect equipment important to safety, consistent with GDC 4, 10 CFR 50.49, and survivability considerations. Second, the RBVS HVAC design should limit radiation exposure to members of the public (portions of the RBVS HVAC ducts are directly across from exterior wall penetrations, or may utilized exterior wall penetrations), consistent with GDC 61 and Part 20, Subpart D. And third, the RBVS HVAC design should limit occupational dose to workers during normal operation and during and following accidents, consistent with GDC 61 and Part 20, Subpart C.

- a) This section should include a statement to the effect that the details of the design of the controls for the RBVS fire dampers, which are also used for limiting the spread of radioactive material during design basis and beyond design basis accidents, are not finalized (i.e., are not within the scope of the certified design), but will be finalized during a future design phase. This section should also indicate that the plant-specific portion of the RBVS HVAC damper controls will meet the interface requirements defined below.
- b) This section should have a statement to the effect that the details of the design of the source term within the RBVS HVAC ducts for the NPMs during design basis and beyond design basis accidents is not finalized (i.e., is not within the scope of the certified design), but will be finalized during a future design phase. This section should also indicate that the plant-specific portion of the description of the RBVS HVAC ducts for the NPM source term content during accidents and the resulting dose rates will meet the interface requirements defined below.

Interface Requirement:

- a) The section should clearly identify the methods (i.e., manual operator actions or automatic signals) that should be used to control the positioning of the fire dampers for limiting the spread of radioactive material out of the RXB pool area during design basis and beyond design basis accidents.
- b) To the extent that the control systems described in item (a) of this interface requirement may allow the spread of post-accident sources of radioactive material into the RBVS HVAC ducts, this section should indicate that the COL applicant will identify the kinds and quantities of radioactive material that may be contained in the ducts and demonstrate that the calculated dose rates resulting from the presence of the material are acceptable, i.e., the doses are within the limits for public and

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occupational exposure, equipment qualification, and survivability specified within the scope of the certified standard design.

This section should include a discussion of the method to be used for the verification of compliance with the interface requirements.

As noted above, an alignment between NuScale and the NRC on the implementation of interface requirements regarding bioshield penetrations and the use of fire dampers for source term control would provide a timely and efficient solution that would allow the staff to complete its evaluation of those areas, which have not yet been fully designed, while meeting the mutual goals discussed above. This is the option preferred by the staff.

The staff has identified alternative approaches for consideration by NuScale, but there are drawbacks to these approaches and these approaches may not support timely resolution of the issues by the end of July 2019.

- NuScale could just remain with the COL Item approach.
 - The staff would do a “carve out” in appendix G of the Part 52 DCD rulemaking to describe those portions of the of the facility that are outside of the scope of the approved design.
 - This approach may involve, delay in the design approval timeframe, notification of the Commission, and the diversion of staff resources from other design review efforts.
 - This approach would not provide any finality in the DCA or rulemaking.
- NuScale could propose Design Acceptance Criteria (DAC).
 - Because the staff has previously told the Commission that it would not use DAC for radiation protection, the staff would need to prepare a SECY paper to inform the Commission that DAC were going to be used to complete the NuScale radiation protection design review.
 - This would involve considerable staff effort, which could divert staff resources away from other areas of the NuScale review effort.
 - Development of the SECY, and consideration by the Commission, would not be able to be accomplished in the desired timeframe.
 - We cannot provide an estimate of when the Commission might complete voting and issue an SRM.

As stated above, the staff believes that by using the Design Interface Requirements approach that the goals of the both NuScale and the staff can be reached in the least time.