RAIO-0318-59229

March 21, 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. 345 (eRAI No. 9294) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 345 (eRAI No. 9294)," dated January 26, 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 Questions from NRC eRAI No. 9294:

- 12.03-23
- 12.03-24
- 12.03-25
- 12.03-26
- 12.03-27

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 Steven Mirsky at 240-833-3001 or at smirsky@nuscalepower.com.

Sincerely,

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

Distribution: Samuel Lee, NRC, OWFN-8G9A
Anthony Markley, NRC, OWFN-8G9A
Prosanta Chowdhury NRC, OWFN-8G9A

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9294

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9294

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
www.nuscalepower.com

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

eRAI No.: 9294
Date of RAI Issue: 01/26/2018

NRC Question No.: 12.03-23

Regulatory Basis

10 CFR 52.47(a)(5) requires applicants to identify the kinds and quantities of radioactive materials expected to be produced in the operation and the means for controlling and limiting radiation exposures within the limits set forth in 10 CFR Part 20.

Appendix A to 10 CFR Part 50— "General Design Criteria for Nuclear Power Plants," Criterion 61—"Fuel storage and handling and radioactivity control," requires systems which may contain radioactivity to be designed with suitable shielding for radiation protection and with appropriate containment, confinement, and filtering systems.

10 CFR 20.1101(b) and 10 CFR 20.1003, require the use of engineering controls to maintain exposures to radiation as far below the dose limits in 10 CFR Part 20 as is practical.

The Acceptance Criteria of DSRS Section 12.3-12.4, "Radiation Protection Design Features," contains a number of criteria related to the design of the shielding, including:

- That the areas inside the plant structures, as well as in the general plant yard, should be subdivided into radiation zones, with maximum design dose rate zones and the criteria used in selecting maximum dose rates identified.
- That the composition of the shielding material should be selected to minimize, to the extent practicable, the potential for the shield itself to become a radiation source (either from activation of the shield material or production of secondary radiation resulting from interactions with the primary radiation).
- Where the applicant's shielding design incorporates material subject to degradation, such as through the effects of radiation (e.g., depletion of boron neutron absorbers,) temperature extremes (e.g., degradation of polymer based materials because of high temperature,) density changes (e.g., sagging or settling of shielding material with age,) methods are in place to ensure that ORE remains ALARA, and the equipment exposures are maintained in accordance with the provisions of 10 CFR 50.49 should be specified
- The application should identify the allowable constraints (e.g., minimum cooling air flow, maximum shielding material temperature, and maximum allowable neutron flux,) and how those parameters are measured and assessed over the design life of the facility.
- That accessible portions of the facility that are capable of having radiation levels greater

than 1 gray (Gy) per hour (100 rads per hour) are shielded, and are clearly marked with a sign stating that potentially lethal radiation fields are possible. If removable shielding is used to reduce dose rates to less than 1 Gy per hour, it must also be explicitly marked as above.

Background

DCD Tier 2 Revision 0 Section 12.3.2, “Shielding,” describes some of the design considerations for radiation shielding, such as stating that material used for a significant portion of plant shielding is concrete.

DCD Section 12.3.2.2, “Design Considerations,” states that the selection of shielding materials considers the ambient environment and potential degradation mechanisms. The material used for a significant portion of plant shielding is concrete. In addition to concrete, other types of materials such as steel, water, tungsten, and polymer composites are considered for both permanent and temporary shielding. DCD Section 12.3.2.4.3, “Reactor Building,” states that cubicle walls are concrete supported by carbon steel plates, called structural steel partition walls.

DCD Table 12.3-6, “Reactor Building Shield Wall Geometry,” provides the nominal thickness of concrete for some of the walls in the RXB. DCD Table 12.3-8, “Reactor Building Radiation Shield Doors,” lists the shielded doors located in the RXB. DCD Table 12.3-7, “Radioactive Waste Building Shield Wall Geometry,” provides the nominal thickness of concrete for some of the walls in the RWB. DCD Table 12.3-9, “Radioactive Waste Building Radiation Shield Doors,” list the shielded doors located in the RWB.

Using information made available to the staff during the RPAC Chapter 12 Audit, the staff identified that some shielding design calculations referenced the use of additional steel (i.e., in addition to the structural steel partition walls already noted,) shielding to limit dose rates in adjacent areas.

Key Issue 1

DCD Tier 2 Revision 0 Section 12.3.2, “Shielding,” does not identify the specific areas where additional shielding is required. DCD Table 12.3-6, “Reactor Building Shield Wall Geometry,” and DCD Table 12.3-7, “Radioactive Waste Building Shield Wall Geometry,” provide the nominal thickness of concrete for some of the walls in the RXB and RWB. However, neither table identifies the location of nor the minimum thickness of any additional steel shielding material.

Question 1

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions regarding the adequacy of the radiation shielding, the staff requests that the applicant:

- Describe the locations in the RXB and RWB where additional steel shielding is credited for the radiation shielding design,

- Justify/explain the assumptions used to perform the shielding analysis in the RXB and the RWB, supporting the amount of steel shielding identified, including the associated methods, models and assumptions used to establish the identified values,
- As necessary, revised section DCD Section 12.3.2, to describe the these steel thicknesses, and the associated assumptions,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

As described in FSAR Section 12.3.2.2, the most prevalent material used for shielding in the NuScale facility design is concrete. Other shielding materials are also included as part of the design, particularly steel. The design of various walls within the NuScale facility includes the use of steel plate lined concrete. The most common occurrence of the use of steel plates is in partition walls in the Reactor Building, which consist of two steel plates with concrete in between. The thickness of these walls includes two one-half inch thick steel plates, which enclose 19 inches of concrete in between, for a total shield thickness of 20 inches, as indicated in FSAR Table 12.3-6.

There are concrete and steel composite slabs in the Reactor Building, which also commonly consist of two one-half inch steel plates, plus 19 inches of concrete in between, for a total shield thickness of 20 inches. As stated in FSAR Section 12.3.2.3, shielding credit is conservatively applied and is in accordance with plant drawings. Shielding credit is not taken for reinforcing steel bars in the concrete.

To clarify the shield modeling assumptions related to steel plates, a footnote will be added to FSAR Table 12.3-6 describing the designed thickness of the steel and concrete for the partition walls and composite slabs.

The LRWS processing skids are vendor packages that will incorporate integral shielding, as required by equipment specifications. Because these processing skid designs are not finalized, and equipment specifications are not yet written, the Radioactive Waste Building shielding analysis modeled additional shielding. The shielding analysis of the Radioactive Waste Building utilizes an additional one-inch thick plate of steel covering the liquid radioactive waste system ion exchange and charcoal bed cubical, and an additional two-inch thick plate of steel covering the drum dryer skid cubicals. The shielding analysis of the solid radioactive waste system models a 4.5-inch thick lead shield around the HIC in the HIC fill station room. FSAR Section 12.3.2.4.4 and Table 12.3-7 will be revised to reflect these additional shields.

Impact on DCA:

FSAR Section 12.3.2.4.4, Table 12.3-6, and Table 12.3-7 have been revised as described in the response above and as shown in the markup provided in this response.

pool. The UHS pool is located below grade in the RXB. The UHS provides shielding for the spent fuel assemblies in the storage racks and the refueling pool as described in Section 9.1 and Section 9.2.5.

Shielding for radiation protection is maintained by the fuel handling equipment as described in Section 9.1.4.

Spent fuel is stored in fuel storage racks in the spent fuel pool, as described in Section 9.1. Due to the depth of water above the stored fuel, the dose rate at the water's surface from the stored fuel is negligible. Likewise, the radiation shielding provided by the pool water and the pool walls surrounding the fuel keeps radiation dose rates in the lower levels of the RXB acceptably small.

12.3.2.4.4 Radioactive Waste Building

The RWB houses significant radiation sources that belong to the radioactive waste processing systems. The specifics of these systems are discussed below. The radiation zone maps are located in Figure 12.3-2a and Figure 12.3-2b.

Liquid Radioactive Waste System

The LRWS is primarily located in the RWB. The low-conductivity waste (LCW) and high-conductivity waste (HCW) sample tanks (two of each) contain liquid radioactive waste water that is processed to comply with discharge or recycle requirements.

The LCW and HCW collection tanks are located in separate shielded compartments in the RWB at elevation 71'-0". The respective transfer pumps for these tanks are located in shared compartments in the RWB at elevation 71'-0". Each pair of transfer pumps is separated by sufficient space to allow room for temporary shielding, as well as space for tools, spare parts, and personnel.

The other LRWS components that are important radiation sources are located in the RWB at elevation 100'-0". Liquid radioactive waste demineralizers and some of the filters are located in a shared shielding labyrinth. Additional filtration systems are located on modular skids with integrated process shielding.

RAI 12.03-23, RAI 12.03-25

Additional shielding is modeled for the processing skids containing the LCW demineralizers, GAC filters, and drum dryer, as noted in Table 12.3-7.

Gaseous Radioactive Waste System

The GRWS system is located in the RWB at elevation 71'-0". GRWS components are generally located in separate, shielded compartments.

The redundant charcoal decay beds each consists of four charcoal vessels that share a shielded compartment, separated by a shield wall. The decay beds are protected by a single guard bed that is in a separately shielded compartment located in the RWB at elevation 71'-0".

The remaining GRW components, consisting of gas heat exchangers (vapor condensers) and moisture separators, occupy a shared shielded compartment, separate from the decay beds and the guard bed, located in the RWB at elevation 71'-0".

Solid Radioactive Waste System

The SRWS is located in the RWB at elevations elevation 71'-0" and elevation 100'-0". SRW components are generally located in separate, shielded compartments.

The two phase separator tanks and the two spent resin tanks are located in individual shielded compartments at elevation 71'-0". The respective transfer pumps for these tanks are located in shared compartments in the RWB at elevation 71'-0". Each pair of transfer pumps is separated by sufficient space to allow room for temporary shielding, as well as space for tools, spare parts, and personnel.

The SRW consists of both Class A and Class B/C waste storage areas. A Class A waste package storage area is located at elevation 100'-0". The Class A high integrity container (HIC) and Class B/C HIC storage area is located at elevation 71'-0". Access to the HIC storage area is through floor shield plugs at elevation 100'-0".

RAI 12.03-23, RAI 12.03-25

Additional shielding is modeled for the HIC process shield, as noted in Table 12.3-7.

12.3.3 Ventilation

The plant heating, ventilating, and air-conditioning systems are designed to provide a controlled environment for personnel and equipment during normal operation. In areas subject to airborne activity, the ventilation systems are designed to collect, process, and exhaust airborne radioactive material, including directing airflow to processed exhausts (Section 9.4.) This section discusses the radiation control considerations of the HVAC systems design.

12.3.3.1 Design Objectives

Design objectives for the plant heating ventilation and air conditioning systems include the following:

- During normal plant operations, the airborne radioactivity levels to which plant personnel are exposed in radiation controlled areas are maintained ALARA and within the limits specified in 10 CFR 20. The airborne radioactivity released during normal plant operations are also maintained ALARA and within the limits of 10 CFR 20, Appendix B, Table II.
- During normal plant operations, the dose from airborne radioactive material exposure in unrestricted areas beyond the site boundary is maintained ALARA and within the limits specified in 10 CFR 20.1301 and 10 CFR 50, Appendix I.

RAI 12.03-23

Table 12.3-6: Reactor Building Shield Wall Geometry

Elev.	Room # (~~see~~ Note 1)	Room Name	North Wall (Note 2)	East Wall (Note 2)	South Wall (Note 2)	West Wall (Note 2)	Floor (Note 3)	Ceiling (Note 3)	Source Term
24’	010-040	Module 1 CVCS ion exchanger sluice room	20” Structural steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	10’ Concrete (ground floor)	20” Concrete/steel composite slab	CVCS mixed bed and CVCS cation bed
24’	010-041	Module 2 CVCS ion exchanger sluice room	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20”Concrete/steel partition wall	10’ Concrete (ground floor)	20” Concrete/steel composite slab	CVCS mixed bed and CVCS cation bed
24’	010-042	Module 3 CVCS ion exchanger sluice room	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20”Concrete/steel partition wall	10’ Concrete (ground floor)	20” Concrete/steel composite slab	CVCS mixed bed and CVCS cation bed
24’	010-043	Module 4 CVCS ion exchanger sluice room	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	10’ Concrete (ground floor)	20” Concrete/steel composite slab	CVCS mixed bed and CVCS cation bed
24’	010-044	Module 5 CVCS ion exchanger sluice room	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	10’ Concrete (ground floor)	20” Concrete/steel composite slab	CVCS mixed bed and CVCS cation bed
24’	010-045	Module 6 CVCS ion exchanger sluice room	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	10’ Concrete (ground floor)	20” Concrete/steel composite slab	CVCS mixed bed and CVCS cation bed
24’	010-051	Module 7 CVCS ion exchanger sluice room	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	10’ Concrete (ground floor)	20” Concrete/steel composite slab	CVCS mixed bed and CVCS cation bed
24’	010-050	Module 8 CVCS ion exchanger sluice room	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	10’ Concrete (ground floor)	20” Concrete/steel composite slab	CVCS mixed bed and CVCS cation bed
24’	010-049	Module 9 CVCS ion exchanger sluice room	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20”Concrete/steel partition wall	10’ Concrete (ground floor)	20” Concrete/steel composite slab	CVCS mixed bed and CVCS cation bed
24’	010-048	Module 10 CVCS ion exchanger sluice room	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	10’ Concrete (ground floor)	20” Concrete/steel composite slab	CVCS mixed bed and CVCS cation bed
24’	010-047	Module 11 CVCS ion exchanger sluice room	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	20” Concrete/steel partition wall	10’ Concrete (ground floor)	20” Concrete/steel composite slab	CVCS mixed bed and CVCS cation bed

Table 12.3-6: Reactor Building Shield Wall Geometry (Continued)

Elev.	Room # (~~see~~ Note 1)	Room Name	North Wall (Note 2)	East Wall (Note 2)	South Wall (Note 2)	West Wall (Note 2)	Floor (Note 3)	Ceiling (Note 3)	Source Term
75′	N/A	Modules 1-6 CVCS vertical pipe chases	20″ Concrete/steel partition wall	20″ Concrete/steel partition wall	5′ Concrete (reactor pool wall)	20″ Concrete/steel partition wall	N/A	N/A	CVCS pipe
75′	N/A	Modules 7-12 CVCS vertical pipe chases	5′ Concrete (reactor pool wall)	20″ Concrete/steel partition wall	20″ Concrete/steel partition wall	20″ Concrete/steel partition wall	N/A	N/A	CVCS pipe
86′	N/A	Modules 1-6 CVCS vertical pipe chases	20″ Concrete/steel partition wall	20″ Concrete/steel partition wall	5′ Concrete (reactor pool wall)	20″ Concrete/steel partition wall	N/A	N/A	CVCS pipe
86′	N/A	Modules 7-12 CVCS vertical pipe chases	5′ Concrete (reactor pool wall)	20″ Concrete/steel partition wall	20″ Concrete/steel partition wall	20″ Concrete/steel partition wall	N/A	N/A	CVCS pipe
100′	N/A	Modules 1-6 CVCS vertical pipe chases	20″ Concrete/steel partition wall	20″ Concrete/steel partition wall	5′ Concrete (reactor pool wall)	20″Concrete/steel partition wall	N/A	N/A	CVCS pipe
100′	N/A	Modules 7-12 CVCS vertical pipe chases	5′ Concrete (reactor pool wall)	20″ Concrete/steel partition wall	20″ Concrete/steel partition wall	20″Concrete/steel partition wall	N/A	N/A	CVCS pipe
126	010-022	Reactor pool area	5' Concrete wall	5' Concrete wall	5' Concrete wall	5' Concrete wall	21.5" Concrete 2" High-density polyethylene 0.25" Steel (Bioshield)	4' Concrete roof	NPM

Note 1: Refer to Figure 1.2-10 through Figure 1.2-18 for room locations.

Note 2: A 20" concrete/steel partition wall consists of two one-half inch steel plates with 19" of concrete in between.

Note 3: A 20" concrete/steel composite slab consists of two one-half inch steel plates with 19" of concrete in between.

RAI 12.03-23, RAI 12.03-25

Table 12.3-7: Radioactive Waste Building Shield Wall Geometry

Elev.	Room #	Room Name	North Wall	East Wall	South Wall	West Wall	Floor	Ceiling	Source Term
71′	030-004	Tank Room	20″ Concrete	20″ Concrete	20″ Concrete	48″ Concrete Wall (Facility External Wall)	60″ Concrete (Facility Basemat)	24″ Concrete	GRWS Charcoal Beds
71′	030-005	Tank Room	20″ Concrete	20″ Concrete	20″ Concrete	48″ Concrete Wall (Facility External Wall)	60″ Concrete (Facility Basemat)	24″ Concrete	GRWS Charcoal Beds
71′	030-012	Tank Room	36″ Concrete	48″ Concrete Wall (Facility External Wall)	15″ Concrete	15″ Concrete	60″ Concrete (Facility Basemat)	24″ Concrete	Phase Separator Tank
71′	030-013	Tank Room	36″ Concrete	15″ Concrete	15″ Concrete	24″ Concrete	60″ Concrete (Facility Basemat)	24″ Concrete	Phase Separator Tank
71′	030-015	Tank Room	36″ Concrete	24″ Concrete	24″ Concrete	24″ Concrete	60″ Concrete (Facility Basemat)	24″ Concrete	HCW Collection Tank
71′	030-016	Tank Room	36″ Concrete	24″ Concrete	24″ Concrete	24″ Concrete	60″ Concrete (Facility Basemat)	24″ Concrete	HCW Collection Tank
71′	030-018	Tank Room	24″ Concrete	24″ Concrete	36″ Concrete	24″ Concrete	60″ Concrete (Facility Basemat)	24″ Concrete	LCW Collection Tank
71′	030-019	Tank Room	24″ Concrete	24″ Concrete	36″ Concrete	24″ Concrete	60″ Concrete (Facility Basemat)	24″ Concrete	LCW Collection Tank
71′	030-020	Tank Room	24″ Concrete	24″ Concrete	36″ Concrete	24″ Concrete	60″ Concrete (Facility Basemat)	24″ Concrete	LCW Sample Tank
71′	030-021	Tank Room	24″ Concrete	24″ Concrete	24″ Concrete	24″ Concrete	60″ Concrete (Facility Basemat)	24″ Concrete	LCW Sample Tank
71′	030-024	Tank Room	24″ Concrete	24″ Concrete	24″ Concrete	24″ Concrete	60″ Concrete (Facility Basemat)	24″ Concrete	HCW Sample Tank
71′	030-025	Tank Room	24″ Concrete	34″ Concrete	24″ Concrete	24″ Concrete	60″ Concrete (Facility Basemat)	24″ Concrete	HCW Sample Tank
71′	030-026	Tank Room	36″ Concrete	34″ Concrete	36″ Concrete	34″ Concrete	60″ Concrete (Facility Basemat)	24″ Concrete	Spent Resin Storage Tank
71′	030-027	Tank Room	36″ Concrete	48″ Concrete Wall (Facility External Wall)	36″ Concrete	34″ Concrete	60″ Concrete (Facility Basemat)	24″ Concrete	Spent Resin Storage Tank
71′	030-033	HIC Filling Room	36″ Concrete (Note 1)	36″ Concrete (Note 1)	36″ Concrete (Note 1)	36″ Concrete (Note 1)	60″ Concrete (Facility Basemat)	24″ Concrete	HIC

Table 12.3-7: Radioactive Waste Building Shield Wall Geometry (Continued)

Elev.	Room #	Room Name	North Wall	East Wall	South Wall	West Wall	Floor	Ceiling	Source Term
71′	030-034	Class A/B/C HIC Room	36″ Concrete	36″ Concrete	36″ Concrete	48″ Concrete Wall (Facility External Wall)	60″ Concrete (Facility Basemat)	24″ Concrete	HIC
82′	---	Pipe Chase	24″ Concrete	24″ Concrete	24″ Concrete	24″ Concrete	20″ Concrete	24″ Concrete	Resin transfer pipe
100′	030-105	LRW Mobile Processing Area	24″ Concrete	36″ Concrete	24″ Concrete	36″ Concrete	24″ Concrete	12″ Concrete - Facility Ceiling (Note 2)	LCW GAC; LCW TUF; LCW RO; HCW GAC; HCW TUF; HCW RO; LCW Cation Demineralizer; LCW Anion Demineralizer; LCW Mixed Bed Demineralizer; LCW Cesium Demineralizer.
100′	030-106	Drum Dryer Room A	24″ Concrete	36″ Concrete	24″ Concrete	12″ Concrete	24″ Concrete	12″ Concrete - Facility Ceiling (Note 3)	Drum Dryer

Note 1: An additional 4.5 inches of lead is credited for a HIC process shield.

Note 2: An additional one inch of steel on top of the LCW demineralizers and GAC processing skids is credited.

Note 3: An additional two inches of steel on top of the drum dryer skid is credited.

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

eRAI No.: 9294
Date of RAI Issue: 01/26/2018

NRC Question No.: 12.03-24

The Regulatory Basis and Background are in RAI-9294 Question 31054

Key Issue 2

DCD Section 12.3.2.2, “Design Considerations,” states that radiation shield doors are designed to have a radiation attenuation capability that meets or exceeds that of the wall within which they are installed. DCD Tier 2 Revision 0 Section 12.3.2, “Shielding,” does not identify the specific areas where additional shielding is required. DCD Table 12.3-8, “Reactor Building Radiation Shield Doors,” and DCD Table 12.3-9, “Radioactive Waste Building Radiation Shield Doors,” provide a listing of the radiation shield doors located in the RXB and RWB. However, neither table identifies the location of nor the minimum thickness of any additional steel shielding material that is used in the rooms the doors are shielding, so it is not clear to the staff which “shielding thickness” applies to the radiation shielding doors, (i.e., just the concrete shielding, or the concrete shielding plus any other shielding enhancements.)

Question 2

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions regarding the adequacy of the radiation shielding, the staff requests that the applicant:

- Describe the locations in the RXB and RWB where additional steel shielding is credited for the radiation shielding design and should also be considered for the radiation shield doors minimum thickness,
- Justify/explain the assumptions used to perform the shielding analysis of the radiation shield doors located in the RXB and the RWB, ,
- As necessary, revised section DCD Section 12.3.2, to describe the these steel thicknesses, and the associated assumptions and any changes to the descriptions of the radiation shield doors,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

As described in FSAR Section 12.3.2.2, for shield walls that contain a door, the door provides an equivalent radiation attenuation as the shield wall that surrounds the door. The location of the shield doors is provided in FSAR Table 12.3-8 and Table 12.3-9, and the shield walls are described in FSAR Table 12.3-6 and Table 12.3-7.

Because the design details for these shield doors are not finalized at this time, the specific materials and thicknesses will be determined at a later date. However, the design thicknesses for these shield doors will provide an equivalent (or greater) radiation attenuation as the surrounding wall in which the shield door is located.

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.: 9294
Date of RAI Issue: 01/26/2018

NRC Question No.: 12.03-25

The Regulatory Basis and Background are in RAI-9294 Question 31054

Key Issue 3

The acceptance criteria of NuScale DSRS section 12.3-12.4, states that accessible portions of the facility that are capable of having radiation levels greater than 1 gray (Gy) per hour (100 rads per hour rads/hr) should be shielded. All accessible portions of the facility capable of having radiation levels greater than 1 Gy per hour (100 rads per hour) are to be clearly marked with a sign stating that potentially lethal radiation fields are possible. If removable shielding is used to reduce dose rates to less than 1 Gy per hour, it must also be explicitly marked as above. DCD Tier 2 Revision 0 Section 12.3.2.4.3, “Reactor Building,” and DCD Section 12.3.2.4.4 , “Radioactive Waste Building,” identify a number of areas, such as resin demineralizers, filters, spent resin storage tanks etc., which may contain quantities of radioactive material resulting in radiation dose rates exceeding 100 rads/hr.

However, DCD Tier 2 Revision 0 Section 12.3.2, “Shielding,” does not identify the specific areas where removable shielding is used. DCD Table 12.3-6, “Reactor Building Shield Wall Geometry,” and DCD Table 12.3-8, “Reactor Building Radiation Shield Doors and DCD Table 12.3-7, “Radioactive Waste Building Shield Wall Geometry,” provide the nominal thickness of concrete for some of the walls in the RXB and RWB. However, neither table identifies the location of removable shielding material. DCD Tier 2 Revision 0 Section 12.3.2, “Shielding,” does not specify that those portions of the facility capable of having radiation levels greater than 1 Gy per hour (100 rads per hour) where removable shielding is used, are clearly marked with a sign stating that potentially lethal radiation fields are possible.

Question 3

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions regarding the adequacy of the radiation shielding, the staff requests that the applicant:

* Describe the locations in the RXB and RWB where removable shielding is credited for the radiation shielding design,
* For those portions of the facility exceeding 100 rads/hr where removable shielding is used describe how the areas are marked,
* As necessary, revised section DCD Section 12.3.2, to include these descriptions of removable shielding and markings,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

The credited removable shielding in a NuScale facility includes the bioshield over each of the NuScale power module (NPM) operating bays in the Reactor Building (RXB), a floor shield plug to the HIC Storage Room in the Radioactive Waste Building (RWB), and a floor shield plug to the HIC filling room, which is also located in the RWB.

As described in FSAR Section 3.7.3.3.2 and Section 9.1.5.2.3, the bioshield is not removed from its normal position until after the associated reactor has been shutdown. The bioshield is handled remotely using the reactor building crane (RBC). As discussed in FSAR Section 11.4.2.4 and Section 12.3.2.4.4, the shield plugs to the HIC storage room and the HIC filling room are removed to move waste containers. The floor shield plugs are handled remotely using the radioactive waste building crane.

The CVCS particulate filters and resin traps are designed to be accessible via removable floor plugs that are equivalent shielding as the flooring. These floor shield plugs are in the floor of CVCS cubicals at the 35'-8" elevation of the Reactor Building. FSAR Section 12.3.2.4.3 has been updated to clarify the removable floor shield plugs.

For the aforementioned removable shielding, appropriate postings and signage will be affixed, as determined by the radiation protection program (COL item 12.5-1).

Impact on DCA:

FSAR Section 12.3.2.4.3 has been revised as described in the response above and as shown in the markup provided in this response.

12.3.2.4 Major Component Shielding Design Description

12.3.2.4.1 NuScale Power Module

An NPM is a self-contained nuclear steam supply system composed of a reactor core, a pressurizer, two steam generators integrated within the reactor pressure vessel, CRDMs and valves, and is housed in a compact steel containment vessel. The containment vessel is partially immersed in the reactor pool as shown in Figure 1.2-5.

Biological shielding is provided above each NPM to allow personnel access above the 126' elevation in the RXB. The bioshield design is described in Section 3.7.3.

The containment vessel, pool water, and pool wall provide shielding and attenuation. The pool wall thickness is used for attenuating radiation from the radiation sources associated with the NPM.

12.3.2.4.2 Main Control Room

The dose rate in the main control room during normal operations is negligible. The Control Building (CRB) room locations and elevations are shown in figures provided in Section 1.2. The CRB walls are designed to attenuate radiation from the RXB. As indicated by Table 15.0-12, the GDC 19 dose acceptance criteria for the control room are met for postulated accidents.

12.3.2.4.3 Reactor Building

In general, the calculated dose rates in open areas and corridors of the RXB are less than five mrem/hr during normal operation as shown in the radiation zone maps (Figure 12.3-1a through Figure 12.3-1i).

The RXB includes systems that contain radioactive components. The major radiation sources in the RXB are associated with the NPM (see Section 12.3.2.4.1), chemical volume and control system, PCUS, and spent fuel storage. The shielding designs for these systems are described below.

Chemical and Volume Control System

The CVCS contains radioactive ion exchangers, filters, and heat exchangers. The CVCS components and piping are located below grade in the RXB as shown in the radiation zone maps. The regenerative and non-regenerative heat exchangers are located at elevation 50'-0". The module heatup system heat exchangers are located at elevation 62'-0". The CVCS reactor coolant makeup filters and the CVCS ion exchangers are located at elevation 24'-0". Access to these areas is restricted and is not required for normal operation of this equipment.

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The filters, ion exchangers, and heat exchangers are located in shielded cubicles with removable access panels. The CVCS filters and resin traps are accessible via removable floor shield plugs at elevation 35'-8" for maintenance purposes. The cubicle walls are concrete supported by carbon steel plates, called structural steel partition walls. The labyrinths in the cubicles provide shielding that significantly lowers the dose rates from areas adjacent to the radioactive component.

The CVCS is equipped with a resin transfer line used to transport resin slurry to the SRWS. The line is generically modeled in the RXB shielding model using the CVCS ion exchanger spectra. Resin transfers are planned evolutions to minimize operator exposure in accordance with ALARA principles.

Primary coolant piping in CVCS equipment rooms is shielded to minimize surveillance and maintenance dose rates. The RCS discharge lines, which travel from the modules to the CVCS heat exchangers and purification equipment through a concrete-shielded pipe chase, are a radioactive source in the CVCS. The pipe chase shielded dose rate from the letdown line is negligible.

The CVCS design features that reduce radiation exposures are described in Section 9.3.4.

Pool Cooling and Cleanup Systems

The pool cooling and cleanup systems, which include the spent fuel cooling system, reactor pool cooling system, and the PCUS are located below grade in the RXB. The PCUS demineralizers and filters are located at elevation 24'-0".

The PCUS demineralizers and filters are located in shielded cubicles that use structural steel partition walls. The dose rates in surrounding areas are acceptable for operations or maintenance activities. The filters are changed in accordance with ALARA principles to minimize personnel exposure.

For purposes of radiation shielding, the spent fuel pool cooling and reactor pool cooling heat exchangers are considered to be a negligible source of external radiation, since tritium constitutes the majority of the radionuclides present.

The design features of the pool cooling and cleanup systems that reduce radiation exposures are described in Section 9.1.3.

Degasifier Room

The LRWS degasifiers receive primary letdown and pressurizer vent flow from the CVCS. The degasifiers and their transfer pumps (both liquid and gaseous) are located within shielded cubicles in the RXB at elevation 24'-0". The degasifier cubicle walls also use structural steel partition walls. The degasifier contributes minor dose rates to the adjacent labyrinth and surrounding corridors and is acceptable for operations and maintenance activities.

Fuel Storage and Handling Systems

The ultimate heat sink (UHS) is a safety-related pool of borated water that consists of the combined water volume of the reactor pool, refueling pool, and spent fuel

NUSCALE POWER™

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

eRAI No.: 9294
Date of RAI Issue: 01/26/2018

NRC Question No.: 12.03-26

The Regulatory Basis and Background are in RAI-9294 Question 31054

Key Issue 4

The acceptance criteria of NuScale DSRS section 12.3-12.4, states that the acceptability of the facility design features will include an assessment of design features provided to protect shielding material subject to degradation, such as through the effects of radiation (e.g., depletion of boron neutron absorbers,) temperature extremes (e.g., degradation of polymer based materials because of high temperature,) density changes (e.g., sagging or settling of shielding material with age). The guidance contained in Regulatory Guide (RG) 1.69, "Concrete Radiation Shields and Generic Shield Testing for Nuclear Power Plants," discusses the use of American Concrete Institute (AC)I 349-06, "Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary," and ACI 349.1R-07, "Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures," and the associated environmental constraints on shielding material.

DCD Tier 2 Section 12.3.1.2.3, "Penetrations," states that if penetrations through shield walls are necessary, the penetrations are designed to minimize streaming (e.g., with an offset) from a radiation source to accessible areas. If penetration offsets are not practical, then penetrations are either shielded or elevated above floor level. DCD Section 12.3.2.2, "Design Considerations," states that in addition to concrete, other types of materials such as steel, water, tungsten, and polymer composites are considered for both permanent and temporary shielding. However, DCD Tier 2 Revision 0 Section 12.3.2, "Shielding," does not identify any areas of the plant shielding (e.g., penetration shielding around hot pipes,) that have limitations associated with the shielding material or for which specific design criteria (e.g., maximum temperature, radiation resistance etc.,) are required for the integrity of the shielding to be maintained.

Question 4

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions regarding the adequacy of the radiation shielding, the staff requests that the applicant:

- Describe the locations in the RXB and RWB where the integrity of radiation shielding may be adversely affected by the local environmental conditions,
- Describe the design features provided to protect the integrity of the radiation shielding at those locations,
- Describe the locations in the RXB and RWB, where materials other than steel or concrete are credited for the shielding design, (e.g., the use of polymeric shielding material, or the use of tungsten,)
- Describe the locations in the RXB and RWB where potentially degradable shielding material is credited for the radiation shielding design, and the associated critical criteria for maintaining integrity of the shielding material,
- If the COL applicant is expected to provide programmatic controls to protect the integrity of the radiation shielding, describe the COL Item that provides that requirement to the COL Applicant,
- As necessary, revised section DCD Section 12.3.2, to include the aforementioned information related to maintaining the integrity of the radiation shielding,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

The radiation shielding design, as described and evaluated in NuScale FSAR Chapter 12, consists of one type of radiation shield that is subject to degradation. That shield is the borated high density polyethylene (HDPE) part of the bioshield which can experience long term boron depletion due to prolonged neutron exposure. The HDPE part of the bioshield design is being removed and replaced with concrete, such that the remaining bioshield shielding materials (steel and concrete) will not be subject to degradation from radiation exposure. This design change is already reflected in Revision 1 of FSAR Chapter 3. The FSAR Chapter 12 shielding evaluation for the revised bioshield design is planned to be incorporated into Revision 2 of the FSAR in 2019.

Other radiation shielding design details and materials related to items, such as shield wall penetration shielding, have not been finalized. As these details are finalized in the design, testing and inspection of potentially degradable shielding materials will be the responsibility of the COL applicant.

As indicated in FSAR Table 1.9-2, the site-specific and programmatic aspects of Regulatory Guide 1.69 are the responsibility of the COL applicant (COL Item 13.5-3).

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.: 9294
Date of RAI Issue: 01/26/2018

NRC Question No.: 12.03-27

The Regulatory Basis and Background are in RAI-9294 Question 31054

Key Issue 5

DCD Tier 1 Revision 0 Section 3.11, ”Reactor Building,” and DCD Tier 1 Section 3.12, ”Radioactive Waste Building,” contain the Inspections, Tests, Analyses, & Acceptance Criteria (ITAAC,) related to the radiation shielding.

DCD Tier 1 Section 3.11, ”Reactor Building,” states that the RXB includes radiation shielding barriers for normal operation and post- accident radiation shielding. It further states that DCD Tier 1 Table 3.11-2, “Reactor Building Inspections, Tests, Analyses, and Acceptance Criteria,” contains the inspections, tests, and analyses for the RXB. DCD Tier 1 Table 3.11-1 item 4 Acceptance Criteria states that the thickness of RXB radiation shielding barriers is greater than or equal to the required thickness specified in DCD Tier 1 Table 3.11-1. DCD Tier 1 Section 3.11 further states that the RXB includes radiation attenuating doors for normal operation and post-accident radiation shielding. These doors have a radiation attenuation capability that meets or exceeds that of the wall within which they are installed.

DCD Tier 1 Section 3.12, ”Radioactive Waste Building,” states that the RWB includes radiation shielding barriers for normal operation and post-accident radiation shielding. Also, the RWB includes radiation attenuating doors for normal operation and for post-accident radiation shielding. These doors have a radiation attenuation capability that meets or exceeds that of the wall within which they are installed. DCD Tier 1 Section 3.12 further states that DCD Tier 1 Table 3.12-2: “Radioactive Waste Building ITAAC” contains the inspections, tests, and analyses for the RWB. DCD Tier 1 Table 3.12-2 item 1 Acceptance Criteria states that the thickness of RWB radiation shielding barriers is greater than or equal to the required thickness specified in DCD Tier 1 Table 3.12-1, “Radioactive Waste Building Shield Wall Geometry.”

DCD Tier 2 Section 12.3.2.2, “Design Considerations,” states that DCD Tier 2 Table 12.3-6 and DCD Tier 2 Table 12.3-7, show the nominal shielding thicknesses for rooms in the RXB and the RWB, respectively. DCD Tier 2 Table 12.3-6, “Reactor Building Shield Wall Geometry,” provides the nominal thickness of concrete for some of the walls in the RXB. DCD Tier 2 Table 12.3-7, “Radioactive Waste Building Shield Wall Geometry,” provides the nominal thickness of concrete for some of the walls in the RWB.

Question 5

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions regarding the adequacy of the radiation shielding and the associated ITAAC, the staff requests that the applicant:

- As necessary, revise DCD Tier 1 Section 3.11 and DCD Tier 1 Section 3.12, and the associated tables, to reflect type and the minimum thicknesses of radiation shielding material, in addition to concrete, used in the RXB and RWB,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

Tier 2, FSAR Table 12.3-6, Reactor Building Shield Wall Geometry and Tier 2, FSAR Table 12.3-7, Radioactive Waste Building Shield Wall Geometry were revised in response to RAI 9294, Question 12.03-23. In the RAI 9294, Question 12.03-23 response, footnotes were added to Tier 2, FSAR Table 12.3-6 to clarify the shield modeling assumptions related to steel plates in the RXB and footnotes were added to Tier 2, FSAR Table 12.3-7 to clarify the shield modeling assumptions in the RWB.

In response to RAI 9294, Question 12.03-27, conforming footnote additions have been made to Tier 1, Table 3.11-1, Reactor Building Shield Wall Geometry and Tier 1, Table 3.12-1, Radioactive Waste Building Shield Wall Geometry.

Impact on DCA:

FSAR Tier 1, Tables 3.11-1 and 3.12-1 have been revised as described in the response above and as shown in the markup provided in this response.

RAI 12.03-27

Table 3.11-1: Reactor Building Shield Wall Geometry

Elev.	Room Name	North Wall (Note 1)	East Wall (Note 1)	South Wall (Note 1)	West Wall (Note 1)	Floor (Note 2)	Ceiling (Note 2)
24′	Module 1 CVCS ion exchanger sluice room	20″ structural steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 2 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 3 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 4 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 5 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 6 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 7 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 8 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 9 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 10 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 11 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 12 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Degasifier room “A”	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)
24′	Degasifier room “B”	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)
24′	Pool cleanup filter room “A”	5′ concrete, RXB wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)
24′	Pool cleanup filter room “B”	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)

Table 3.11-1: Reactor Building Shield Wall Geometry (Continued)

Elev.	Room Name	North Wall (Note 1)	East Wall (Note 1)	South Wall (Note 1)	West Wall (Note 1)	Floor (Note 2)	Ceiling (Note 2)
24′	Pool cleanup system (PCUS) demin room #1	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)
24′	PCUS demin room #2	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)
24′	PCUS demin room #3	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)
35-8″	Module 1 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 2 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 3 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 4 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 5 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 6 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 7 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 8 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 9 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 10 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 11 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 12 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
50′	Module 1 CVCS heat exchanger room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 2 CVCS heat exchanger room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab

Table 3.11-1: Reactor Building Shield Wall Geometry (Continued)

Elev.	Room Name	North Wall (Note 1)	East Wall (Note 1)	South Wall (Note 1)	West Wall (Note 1)	Floor (Note 2)	Ceiling (Note 2)
50′	Module 3 CVCS heat exchanger room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 4 CVCS heat exchanger room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 5 CVCS heat exchanger room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 6 CVCS heat exchanger room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 7 CVCS heat exchanger room	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ structural steel partition wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20″ structural steel partition wall
50′	Module 8 CVCS heat exchanger room	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ structural steel partition wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 9 CVCS heat exchanger room	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ structural steel partition wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 10 CVCS heat exchanger room	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ structural steel partition wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 11 CVCS heat exchanger room	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ structural steel partition wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 12 CVCS heat exchanger room	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ structural steel partition wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Vertical pipe chase	20″ concrete	20″ concrete	20″ concrete	5′ concrete (RXB exterior)	N/A	N/A
62′	Modules 1-6 heatup heat exchangers	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 75′ elevation)
62′	Modules 7-12 heatup heat exchangers	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 75′ elevation)
75′	Modules 1-6 CVCS vertical pipe chases	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	N/A	N/A
75′	Modules 7-12 CVCS vertical pipe chases	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	N/A	N/A
86′	Modules 1-6 CVCS vertical pipe chases	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	N/A	N/A
86′	Modules 7-12 CVCS vertical pipe chases	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	N/A	N/A

Table 3.11-1: Reactor Building Shield Wall Geometry (Continued)

Elev.	Room Name	North Wall (Note 1)	East Wall (Note 1)	South Wall (Note 1)	West Wall (Note 1)	Floor (Note 2)	Ceiling (Note 2)
100′	Modules 1-6 CVCS vertical pipe chases	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	N/A	N/A
100′	Modules 7-12 CVCS vertical pipe chases	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	N/A	N/A
126′	Reactor pool area	5′ concrete wall	5′ concrete wall	5′ concrete wall	5′ concrete wall	21.5″ concrete, 2″ high-density polyethylene, 0.25″ steel (Bioshield)	4′ concrete roof

Note 1: A 20″ concrete/steel partition wall consists of two one-half inch steel plates with 19″ of concrete in between.
Note 2: A 20″ concrete/steel composite slab consists of two one-half inch steel plates with 19″ of concrete in between.

RAI 12.03-27

Table 3.12-1: Radioactive Waste Building Shield Wall Geometry

Elev.	Room Name	North wall	East wall	South wall	West wall	Floor	Ceiling
71′	Tank room	20″ concrete	20″ concrete	20″ concrete	48″ concrete wall (Facility external wall)	60″ concrete (Facility basemat)	24″ concrete
71′	Tank room	20″ concrete	20″ concrete	20″ concrete	48″ concrete wall (Facility external wall)	60″ concrete (Facility basemat)	24″ concrete
71′	Tank room	36″ concrete	48″ concrete wall (Facility external wall)	15″ concrete	15″ concrete	60″ concrete (Facility basemat)	24″ concrete
71′	Tank room	36″ concrete	15″ concrete	15″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	36″ concrete	24″ concrete	24″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	36″ concrete	24″ concrete	24″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	24″ concrete	24″ concrete	36″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	24″ concrete	24″ concrete	36″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	24″ concrete	24″ concrete	36″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	24″ concrete	24″ concrete	24″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	24″ concrete	24″ concrete	24″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	24″ concrete	34″ concrete	24″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	36″ concrete	34″ concrete	36″ concrete	34″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	36″ concrete	48″ concrete wall (Facility external wall)	36″ concrete	34″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	High integrity container filling room	36″ concrete (Note 1)	36″ concrete (Note 1)	36″ concrete (Note 1)	36″ concrete (Note 1)	60″ concrete (facility basemat)	24″ concrete
71′	Class A/B/C high integrity container room	36″ concrete	36″ concrete	36″ concrete	48″ concrete wall (Facility external wall)	60″ concrete (facility basemat)	24″ concrete
82′	Pipe chase	24″ concrete	24″ concrete	24″ concrete	24″ concrete	20″ concrete	24″ concrete
100′	Liquid radioactive waste mobile processing area	24″ concrete	36″ concrete	24″ concrete	36″ concrete	24″ concrete	12″ concrete - Facility ceiling (Note 2)
100′	Drum dryer room A	24″ concrete	36″ concrete	24″ concrete	12″ concrete	24″ concrete	12″ concrete - Facility ceiling (Note 3)

Note 1: An additional 4.5″ of lead is credited for a high integrity container process shield.
Note 2: An additional one inch of steel on top of the low-conductivity waste demineralizers and granulated activated charcoal processing skid inside the liquid radioactive waste mobile processing area is credited.
Note 3: An additional two inches of steel on top of the drum dryer is credited.