

NuScaleDCRaisPEm Resource

From: Cranston, Gregory
Sent: Friday, January 26, 2018 11:33 AM
To: RAI@nuscalepower.com
Cc: NuScaleDCRaisPEm Resource; Lee, Samuel; Chowdhury, Prosanta; Dudek, Michael; Lavera, Ronald; Markley, Anthony
Subject: RE: Request for Additional Information No. 343 RAI No. 9298 (12.3)
Attachments: Request for Additional Information No. 343 (eRAI No. 9298).pdf

Attached please find NRC staff's request for additional information concerning review of the NuScale Design Certification Application.

Please submit your technically correct and complete response within 60 days of the date of this RAI to the NRC Document Control Desk. . The NRC Staff recognizes that NuScale has preliminarily identified that the response to the questions in this RAI are likely to require greater than 60 days. NuScale is expected to provide a schedule for the RAI response by email within 14 days.

If you have any questions, please contact me.

Thank you.

Gregory Cranston, Senior Project Manager
Licensing Branch 1 (NuScale)
Division of New Reactor Licensing
Office of New Reactors
U.S. Nuclear Regulatory Commission
301-415-0546

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Options

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Request for Additional Information No. 343 (eRAI No. 9298)

Issue Date: 01/26/2018

Application Title: NuScale Standard Design Certification - 52-048

Operating Company: NuScale Power, LLC

Docket No. 52-048

Review Section: 12.03-12.04 - Radiation Protection Design Features

Application Section: 12.3, 12.2

QUESTIONS

12.03-17

Regulatory Basis

Appendix A to Part 50—General Design Criteria (GDC) for Nuclear Power Plants, Criterion 4 requires applicants to ensure that structures, systems, and components important to safety are designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation and postulated accidents.

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 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,” notes that 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,) the reviewer should ensure that methods are in place to ensure that ORE remains ALARA. The staff should review how the application identifies 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. The acceptance criteria of NuScale DSRS section 12.3-12.4 states that the applicant’s methods for performing shielding design calculations are acceptable if assumptions regarding source terms, cross sections, shield and source geometries, and transport methods are realistic; and if specified radiation zones are consistent with the assumed source term and shielding specified in the design.

Background

DCD Tier 2 Revision 0 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. The only location where the use of polyethylene is identified is in DCD Table 12.3-6: “Reactor Building Shield Wall Geometry.”

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,” list the shielded doors located in the RXB. DCD Table 12.3-9: “Radioactive Waste Building Radiation Shield Doors,” list the shielded doors located in the RWB. DCD Section 12.3 does not contain any information about the assumption for concrete density, other than the references to ANSI/ANS 6.4-2006 and PNNL-25870.

Using information made available to the staff during the RPAC Chapter 12 Audit, the staff reviewed some of the shielding calculation information for the RXB and the RWB. The staff noticed that the polyethylene shielding specified for the bioshield cover is high density polyethylene and includes 5% natural boron.

Based on information made available to the staff during the RPAC Chapter 12 a, the staff was able to review some of the assumptions used for the RXB shielding analysis. However, the RXB MCNP6 analysis package for the RXB was not available for staff review, so the staff was unable to assess what values were used in the actual RXB shielding calculations.

The acceptance criteria of NuScale DSRS section 12.3-12.4 states that the applicant’s methods for performing shielding design calculations are acceptable if assumptions regarding source terms, cross sections, shield and source geometries, and transport methods are realistic; and if specified radiation zones are consistent with the assumed source term and shielding specified in the design.

Key Issue 1

DCD Tier 2 Section 12.3.2, "Shielding," DCD Section 12.3.2.3, "Calculation Methods," and DCD Section 12.3.2.4.3, "Reactor Building," do not specify the values of key assumptions, such as minimum polyethylene density, or that the polyethylene is supposed to contain boron; nor the minimum weight percent of boron in the polyethylene documented.

Question 1

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions with respect to the neutron shielding materials incorporated into the design, the staff requests that the applicant:

- Justify/explain the assumptions used to perform the neutron shielding analysis for the bioshield polyethylene shielding, including the associated methods, models and assumptions used to establish the identified values,
- As necessary, revise DCD Section 12.3.2, and Table 12.3-6 to describe these assumptions

OR

Provide the specific alternative approaches used and the associated justification.

12.03-18

The Regulatory Basis and Background are in RAI-9298 Q-31062

Key Issue 2

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. However, there is no specification for the boron content of the polyethylene listed in DCD Tier 1 Table 3.11, and there is no description of the minimum polyethylene density.

DCD Tier 2 Section 12.3.2.2, "Design Considerations," states that DCD Tier 2 Table 12.3-6 shows the nominal shielding thicknesses for rooms in plant buildings. 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. However, there is no specification for the boron content of the polyethylene listed in DCD Tier 2 Table 12.3-6.

Question 2

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions with respect to the neutron shielding materials incorporated into the design, the staff requests that the applicant:

- As necessary, revise DCD Tier 1 Section 3.11 and DCD Tier 1 Table 3.11-1, to include the description of boron in the polyethylene shielding material and the density of the polyethylene material,
- As necessary, revise DCD Tier 2 Section 12.3.2.2 and DCD Table 12.3-6, to include the description of boron in the polyethylene shielding material and the density of the polyethylene material,

OR

Provide the specific alternative approaches used and the associated justification.

12.03-19

The Regulatory Basis and Background are in RAI-9298 Q-31062

Key Issue 3

The Acceptance Criteria of DSRS Section 12.3-12.4, "Radiation Protection Design Features," notes that 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,) methods are in place to ensure the integrity of the shielding, and how the application identifies the constraints (e.g., minimum cooling air flow, maximum shielding material temperature, and maximum allowable neutron flux,) and how those parameters are measured, assessed over the design life of the facility.

Question 3

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions with respect to the neutron shielding materials incorporated into the design, the staff requests that the applicant:

- Justify/explain the design features and required constraints needed to ensure the integrity of the shielding over the design life of the plant,
- Explain/Justify the control mechanisms proposed to ensure that the constraints needed to ensure the integrity of the radiation shielding over the design life of the plant,
- As necessary, revise DCD Section 12.3.2, to describe these parameters, and the associated controls (e.g., COL Item,)

OR

Provide the specific alternative approaches used and the associated justification.

12.03-20

The Regulatory Basis and Background are in RAI-9298 Q-31062

Key Issue 4

DCD Tier 2 Revision 0 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, the only location where the use of shielding material other than concrete is identified, is the polyethylene identified in DCD Table 12.3-6: "Reactor Building Shield Wall Geometry." Based on information made available to the staff during the RPAC Chapter 12 Audit, it appears that the shielding design also credits a number of steel/iron plates that are provided for other than structural support.

Question 4

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions with respect to the neutron shielding materials incorporated into the design, the staff requests that the applicant:

- Identify those areas, outside of the Containment Vessel, where steel/iron material is specifically credited for shielding,
- Identify other areas of the plant where shielding material other than concrete, steel/iron are used,
- As necessary, revise DCD Section 12.3.2, and to describe this shielding material,
- Justify/explain the design features and required operational constraints to ensure the integrity of the shielding over the design life of the plant,
- As necessary, revised section DCD Section 12.3.2, and to describe these parameters,

OR

Provide the specific alternative approaches used and the associated justification.