

NuScaleDCRaisPEm Resource

From: Cranston, Gregory
Sent: Friday, June 09, 2017 3:36 PM
To: RAI@nuscalepower.com
Cc: NuScaleDCRaisPEm Resource; Lee, Samuel; Chowdhury, Prosanta; Burkhart, Lawrence; Vera Amadiz, Marieliz; Stutzcage, Edward
Subject: Request for Additional Information No. 54, RAI 8837
Attachments: Request for Additional Information No. 54 (eRAI No. 8837).pdf

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

Please submit your response within 60 days of the date of this RAI to the NRC Document Control Desk.

If you have any questions, please contact me.

Thank you.

Gregory Cranston, Senior Project Manager
Licensing Branch 1 (NuScale)
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Request for Additional Information No. 54 (eRAI No. 8837)

Issue Date: 06/08/2017

Application Title: NuScale Standard Design Certification - 52-048

Operating Company: NuScale Power, LLC

Docket No. 52-048

Review Section: 03.11 - Environmental Qualification of Mechanical and Electrical Equipment

Application Section: DCD Section 3.11 and Appendix 3C

QUESTIONS

03.11-1

Regulatory Basis

10 CFR 50.49 and 10 CFR Part 50, Appendix A, Criterion 4 require that certain components important to safety be designed to withstand environmental conditions, including the effects of radiation, associated with design basis events, including normal operation, anticipated operational occurrences, and design basis accidents.

DSRS Section 3.11 indicates that the applicant's safety analysis report should be sufficient to support the conclusion that all equipment that are important to safety are capable of performing their design safety functions under all environmental conditions that may result from any normal mode of plant operation, anticipated operational occurrence, design basis events, and post-design basis events.

DSRS Section 3.11 also states that the staff will conclude that the environmental design and qualification of mechanical, electrical, and I&C equipment that are important to safety are acceptable and meet applicable regulations, based on the finding that the applicant has implemented an environmental design and qualification program that provides adequate assurance that mechanical, electrical, and I&C equipment that are important to safety will function as intended in the event of anticipated operational occurrences, as well as in the normal, accident, and post-accident environmental conditions. The applicant's environmental design and qualification program should be in accordance with the requirements and guidance described in the regulations, regulatory guides and industry standards identified in Subsection II of DSRS Section 3.11.

Finally, RGs 1.89 and 1.183 provide guidance on how to perform the radiological analysis related to equipment qualification. These guides indicate that assuming 1% failed fuel cladding or the technical specification primary coolant activity limits, would be an acceptable assumption to use in calculating the normal operation equipment qualification dose.

Question

Note 2 of DCD Table 3C-6, indicates that EQ Zones J, K, L, M, and N are designated as harsh environments in the RXB because these areas contain high and/or moderate energy piping. However, while the DCD provides total integrated dose (TID) information for EQ Zones A through I, no TID information is provided for EQ Zones J, K, L, M, and N and therefore, no information is provided regarding what TID the equipment in these areas is required to be designed to. Staff notes that even with the non-conservative and low assumed fuel percentage of 0.028%, some of the areas within these zones would likely result in harsh radiological environments based only on the normal operation source terms. Therefore;

- a. Please provide the maximum TID values for EQ Zones J, K, L, M, and N in the DCD and describe how they are calculated.
- b. Specify if each of these zones is radiologically harsh or mild in the DCD.
- c. Describe how it is determined what radiation TID values equipment in these areas are required to be designed to and update the DCD appropriately.

03.11-2

Regulatory Basis

10 CFR 50.49 and 10 CFR Part 50, Appendix A, Criterion 4 require that certain components important to safety be designed to withstand environmental conditions, including the effects of radiation, associated with design basis events, including normal operation, anticipated operational occurrences, and design basis accidents.

DSRS Section 3.11 indicates that the applicant's safety analysis report should be sufficient to support the conclusion that all equipment that are important to safety are capable of performing their design safety functions under all environmental conditions that may result from any normal mode of plant operation, anticipated operational occurrence, design basis events, and post-design basis events.

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Finally, RGs 1.89 and 1.183 provide guidance on how to perform the radiological analysis related to equipment qualification. These guides indicate that assuming 1% failed fuel cladding or the technical specification primary coolant activity limits, would be an acceptable assumption to use in calculating the normal operation equipment qualification dose.

Question

DCD Table 3C-8 provides accident EQ radiation dose information. Table 3C-8 indicates that it provides integrated beta and integrated gamma dose rates. The table indicates that integrated gamma includes fission gamma, gammas from neutrons, and gammas from coolant. However, during design basis accidents it would appear that the reactors should be shut down. Therefore, there would not be expected to be significant amounts of fissions or neutrons. Please discuss how nuclear fission and neutrons contribute to the accident EQ radiation doses. Also, if Table 3C-8 is inaccurate, please update as appropriate.

03.11-3

Regulatory Basis

10 CFR 50.49 and 10 CFR Part 50, Appendix A, Criterion 4 require that certain components important to safety be designed to withstand environmental conditions, including the effects of radiation, associated with design basis events, including normal operation, anticipated operational occurrences, and design basis accidents.

DSRS Section 3.11 indicates that the applicant's safety analysis report should be sufficient to support the conclusion that all equipment that are important to safety are capable of performing their design safety functions under all environmental conditions that may result from any normal mode of plant operation, anticipated operational occurrence, design basis events, and post-design basis events.

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Finally, RGs 1.89 and 1.183 provide guidance on how to perform the radiological analysis related to equipment qualification. These guides indicate that assuming 1% failed fuel cladding or the technical specification primary coolant activity limits, would be an acceptable assumption to use in calculating the normal operation equipment qualification dose.

Question

DCD Table 3C-8 indicates that the accident integrated doses one hour after an accident in all areas is zero. Given that NuScale has stated that it followed RG 1.183, the staff cannot confirm that NuScale has applied guidance in Section 3.3 regarding release

timing. Please provide additional information explaining how Section 3.3 was implemented or justification for the alternative approach applied.

03.11-4

Regulatory Basis

10 CFR 50.49 and 10 CFR Part 50, Appendix A, Criterion 4 require that certain components important to safety be designed to withstand environmental conditions, including the effects of radiation, associated with design basis events, including normal operation, anticipated operational occurrences, and design basis accidents.

DSRS Section 3.11 indicates that the applicant's safety analysis report should be sufficient to support the conclusion that all equipment that are important to safety are capable of performing their design safety functions under all environmental conditions that may result from any normal mode of plant operation, anticipated operational occurrence, design basis events, and post-design basis events.

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Finally, RGs 1.89 and 1.183 provide guidance on how to perform the radiological analysis related to equipment qualification. These guides indicate that assuming 1% failed fuel cladding or the technical specification primary coolant activity limits, would be an acceptable assumption to use in calculating the normal operation equipment qualification dose.

Question

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The DCD doesn't describe the assumptions used to determine radiological conditions outside of containment and inside the plant for EQ purposes during and following accidents. For example, there is no discussion of accident source terms outside of containment or radioactive material released to the plant atmosphere following design basis accidents and how it impacts the TID to equipment. In addition, there is no information available for staff to assess the radiological conditions in the general plant areas during and following an accident (such as radiation zone maps). These assumptions and information are important in demonstrating that the requirements of 10 CFR 50.49 and GDC 4 are met. Please provide this information.

03.11-5

Regulatory Basis

10 CFR 50.49 and 10 CFR Part 50, Appendix A, Criterion 4 require that certain components important to safety be designed to withstand environmental conditions, including the effects of radiation, associated with design basis events, including normal operation, anticipated operational occurrences, and design basis accidents.

DSRS Section 3.11 indicates that the applicant's safety analysis report should be sufficient to support the conclusion that all equipment that are important to safety are capable of performing their design safety functions under all environmental conditions that may result from any normal mode of plant operation, anticipated operational occurrence, design basis events, and post-design basis events.

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Finally, RGs 1.89 and 1.183 provide guidance on how to perform the radiological analysis related to equipment qualification. These guides indicate that assuming 1% failed fuel cladding or the technical specification primary coolant activity limits, would be an acceptable assumption to use in calculating the normal operation equipment qualification dose.

Question

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In DCD Section 3C.4.1, under "Harsh Environment" it states that, "The equipment requiring qualification for a harsh environment, as identified in Section 3.11, includes the following." Then there are five bullets. The fifth bullet states, "equipment subject to environmental conditions that are more severe for other parameters (e.g., temperature, pressure, humidity, flood level, spray/wetting, radiation) such as those resulting from a fuel handling accident or moderate-energy line break." The basis, intent, and practical implementation of this bullet is not clear. Please clarify the intent of this bullet and its practical application for NuScale equipment design and update the DCD accordingly.

03.11-6

Regulatory Basis

10 CFR 50.49 and 10 CFR Part 50, Appendix A, Criterion 4 require that certain components important to safety be designed to withstand environmental conditions, including the effects of radiation, associated with design basis events, including normal operation, anticipated operational occurrences, and design basis accidents.

DSRS Section 3.11 indicates that the applicant's safety analysis report should be sufficient to support the conclusion that all equipment that are important to safety are capable of performing their design safety functions under all environmental conditions that may result from any normal mode of plant operation, anticipated operational occurrence, design basis events, and post-design basis events.

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Finally, RGs 1.89 and 1.183 provide guidance on how to perform the radiological analysis related to equipment qualification. These guides indicate that assuming 1% failed fuel cladding or the technical specification primary coolant activity limits, would be an acceptable assumption to use in calculating the normal operation equipment qualification dose.

Question

DCD Section 3C.4.3, under "Radiation Dose Effects," states, "In general, dose rate effects occur over long periods and, therefore, need only be addressed during the radiation conditions that occur during normal plant operation."

- a. This statement appears inconsistent with other information in the DCD which indicates that both normal operation and accident conditions are considered. For example, DCD Section 3C.5.4, under "Design Basis Event Radiation Doses" states, "The required dose used for environmental qualification considers the total integrated dose consisting of the normal dose plus the accident dose corresponding to the required post-accident operating time. The normal dose considers gamma and neutron effects, while the accident dose considers the gamma and beta dose that is expected at the equipment location." Please explain how accident conditions have been considered and ensure that the DCD is consistent.
- b. If accident conditions have been categorically excluded, please provide additional technical justification for excluding their consideration.
- c. In addition, please describe any situations when the dose rate received during accident conditions has been or needs to be included.

03.11-7

Regulatory Basis

10 CFR 50.49 and 10 CFR Part 50, Appendix A, Criterion 4 require that certain components important to safety be designed to withstand environmental conditions, including the effects of radiation, associated with design basis events, including normal operation, anticipated operational occurrences, and design basis accidents.

DSRS Section 3.11 indicates that the applicant's safety analysis report should be sufficient to support the conclusion that all equipment that are important to safety are capable of performing their design safety functions under all environmental conditions that may result from any normal mode of plant operation, anticipated operational occurrence, design basis events, and post-design basis events.

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Finally, RGs 1.89 and 1.183 provide guidance on how to perform the radiological analysis related to equipment qualification. These guides indicate that assuming 1% failed fuel cladding or the technical specification primary coolant activity limits, would be an acceptable assumption to use in calculating the normal operation equipment qualification dose.

Question

DCD Section 3C.4.4 states, "Equipment required to be environmentally qualified has one or more of the following design functions related to safety: reactor trip, engineered safeguards actuation, post-accident monitoring, or containment isolation." It is not clear to the staff how this list was developed. 10 CFR 50.49, specifies that equipment required to maintain safe shutdown and non-safety related equipment whose failure could prevent satisfactorily accomplishing a safety-function, must also be qualified. Please explain how this list comprehensively meets the requirements of 10 CFR 50.49. Please update the DCD accordingly and ensure that additional equipment does not need to be added to DCD Table 3.11-1, as a result.

03.11-8

Regulatory Basis

10 CFR 50.49 and 10 CFR Part 50, Appendix A, Criterion 4 require that certain components important to safety be designed to withstand environmental conditions, including the effects of radiation, associated with design basis events, including normal operation, anticipated operational occurrences, and design basis accidents.

DSRS Section 3.11 indicates that the applicant's safety analysis report should be sufficient to support the conclusion that all equipment that are important to safety are capable of performing their design safety functions under all environmental conditions that may result from any normal mode of plant operation, anticipated operational occurrence, design basis events, and post-design basis events.

DSRS Section 3.11 also states that the staff will conclude that the environmental design and qualification of mechanical, electrical, and I&C equipment that are important to safety are acceptable and meet applicable regulations, based on the finding that the applicant has implemented an environmental design and qualification program that provides adequate assurance that mechanical, electrical, and I&C equipment that are important to safety will function as intended in the event of anticipated operational occurrences, as well as in the normal, accident, and post-accident environmental conditions. The applicant's environmental design and qualification program should be in accordance with the requirements and guidance described in the regulations, regulatory guides and industry standards identified in Subsection II of DSRS Section 3.11.

Finally, RGs 1.89 and 1.183 provide guidance on how to perform the radiological analysis related to equipment qualification. These guides indicate that assuming 1% failed fuel cladding or the technical specification primary coolant activity limits, would be an acceptable assumption to use in calculating the normal operation equipment qualification dose.

Question

DCD Section 3.11.5.2 specifies that "the radiation doses are continuously monitored during plant life and compared to the calculated doses. If the measured doses are higher than the calculated doses, the EQ Master List will be revised if an affected mild

environment becomes harsh.” This description does not explain how equipment located in harsh conditions will be monitored and managed throughout plant life. As discussed in numerous places in the DCD, equipment located in harsh environmental zones is designed to perform under all appropriate environmental conditions. So if the dose in a harsh environment is higher than the calculated dose, it could possibly result in a TID (including consideration for postulated accidents) which exceeds the TID for which the equipment in that area was designed to withstand. Therefore, please discuss in the DCD any necessary actions that may be necessary if the measured dose is higher than the calculated dose for equipment located in harsh environments.

03.11-9

Regulatory Basis

10 CFR 50.49 and 10 CFR Part 50, Appendix A, Criterion 4 require that certain components important to safety be designed to withstand environmental conditions, including the effects of radiation, associated with design basis events, including normal operation, anticipated operational occurrences, and design basis accidents.

DSRS Section 3.11 indicates that the applicant’s safety analysis report should be sufficient to support the conclusion that all equipment that are important to safety are capable of performing their design safety functions under all environmental conditions that may result from any normal mode of plant operation, anticipated operational occurrence, design basis events, and post-design basis events.

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Finally, RGs 1.89 and 1.183 provide guidance on how to perform the radiological analysis related to equipment qualification. These guides indicate that assuming 1% failed fuel cladding or the technical specification primary coolant activity limits, would be an acceptable assumption to use in calculating the normal operation equipment qualification dose.

Question

DCD Section 15.0.3.8.1 discusses line breaks outside of containment, including chemical and volume control system (CVCS) line breaks. It is unclear if CVCS line breaks have been considered in the EQ analysis and how CVCS line breaks could affect equipment outside containment requiring qualification. Therefore, please discuss doses outside containment as a result of potential line breaks and how the doses effect the TIDs of equipment and zones outside of containment.

03.11-10

Regulatory Basis

10 CFR 50.49 and 10 CFR Part 50, Appendix A, Criterion 4 require that certain components important to safety be designed to withstand environmental conditions, including the effects of radiation, associated with design basis events, including normal operation, anticipated operational occurrences, and design basis accidents.

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and qualification program should be in accordance with the requirements and guidance described in the regulations, regulatory guides and industry standards identified in Subsection II of DSRS Section 3.11.

Finally, RGs 1.89 and 1.183 provide guidance on how to perform the radiological analysis related to equipment qualification. These guides indicate that assuming 1% failed fuel cladding or the technical specification primary coolant activity limits, would be an acceptable assumption to use in calculating the normal operation equipment qualification dose.

Question

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In DCD Section 3C.5, under Environmental Qualification of Mechanical Equipment, it states that, "Equipment that only has the design function related to safety of maintaining its structural integrity, for support or to protect the integrity of a pressure boundary, is qualified in accordance with the requirements specified in Section 5.2.1." There is no discussion of the effects of radiation on equipment in DCD Section 5.2.1. Please discuss how the effects of radiation are considered for equipment that only has the design function related to safety of maintaining its structural integrity. Update the DCD as appropriate.

03.11-11

Regulatory Basis

10 CFR 50.49 and 10 CFR Part 50, Appendix A, Criterion 4 require that certain components important to safety be designed to withstand environmental conditions, including the effects of radiation, associated with design basis events, including normal operation, anticipated operational occurrences, and design basis accidents.

DSRS Section 3.11 indicates that the applicant's safety analysis report should be sufficient to support the conclusion that all equipment that are important to safety are capable of performing their design safety functions under all environmental conditions that may result from any normal mode of plant operation, anticipated operational occurrence, design basis events, and post-design basis events.

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Finally, RGs 1.89 and 1.183 provide guidance on how to perform the radiological analysis related to equipment qualification. These guides indicate that assuming 1% failed fuel cladding or the technical specification primary coolant activity limits, would be an acceptable assumption to use in calculating the normal operation equipment qualification dose.

Question

DCD Section 3C.4.2, under Radiation Aging, states that, "Radiation aging may be performed separately from the accident radiation exposure or the accident radiation exposure may be performed as part of the radiation aging." Please clarify the intent of this statement.

1. Is the intent to say that in some cases accident radiation exposure is not considered in combination with the normal operational radiation exposure? If so, please justify why it is acceptable to not consider the total integrated dose to components and only to consider the normal operation and accident exposure separately. In addition, provide additional information regarding when this approach is applied; or

2. Is the intent that one device can be radiation aged, while another device can be tested for accident dose? If so, please justify why it is acceptable to use this approach and provide additional information regarding when this approach is applied.