

## NuScaleDCRaisPEm Resource

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**Sent:** Friday, August 18, 2017 11:31 AM  
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**Cc:** NuScaleDCRaisPEm Resource; Lee, Samuel; Chowdhury, Prosanta; Samaddar, Sujit; Neuhausen, Alissa; Markley, Anthony  
**Subject:** Request for Additional Information No. 187, RAI 9014 (9.1.2)  
**Attachments:** Request for Additional Information No. 187 (eRAI No. 9014).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 one or more questions in this RAI is 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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## Request for Additional Information No. 187 (eRAI No. 9014)

Issue Date: 08/18/2017

Application Title: NuScale Standard Design Certification - 52-048

Operating Company: NuScale Power, LLC

Docket No. 52-048

Review Section: 09.01.02 - New and Spent Fuel Storage

Application Section: 9.1.2

### QUESTIONS

09.01.02-3

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10 CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. SRP Sections 9.1.2 and DSRS Sections 3.8.4 Appendix D describe the specific SRP acceptance criteria for the review of the fuel racks to meet the requirements of the Commission's regulations identified above.

On page 197, Section 3.1.5.5.4, the applicant provided the evaluation for the stuck fuel assembly. The applicant states, "A conservative net force of  $F_s = 1200$  lb. is considered to act upwards at the bottom of the fuel tube." The applicant should provide the basis for the magnitude of the net force and explain why it is conservative.

09.01.02-4

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10 CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. SRP Sections 9.1.2 and DSRS Sections 3.8.4 Appendix D describe the specific SRP acceptance criteria for the review of the fuel racks to meet the requirements of the Commission's regulations identified above.

Based on the staff review of NuScale FSAR Tier 2 Section 9.1.2, "New and Spent Fuel Storage," the staff finds that additional information will be needed by the COL applicant to incorporate the DC by reference. Therefore, the staff requests that the applicant provide a COL Item to address site-specific procedures for the measurement of post-seismic gaps between racks and between walls and racks and, if required, the repositioning of the racks to re-establish the gaps specified in the design-basis seismic analysis of the racks.

09.01.02-5

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10 CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. SRP Sections 9.1.2 and DSRS Sections 3.8.4 Appendix D describe the specific SRP acceptance criteria for the review of the fuel racks to meet the requirements of the Commission's regulations identified above. DSRS 3.8.4 (I)(7) in part states that the applicant should describe materials, quality control procedures, and any special construction techniques.

Neither NuScale FSAR Tier 2, Section 9.1.2 nor the Technical Report addresses the governing quality assurance/quality control (QA/QC) requirements and procedures for the design and construction of the spent fuel storage racks. There is no information about the manufacturing process; the fabrication techniques; and the sequences used for constructing the fuel storage racks, in order to minimize

fabrication distortions and to provide accessibility for welding. The staff requests the applicant identify the governing QA/QC I requirements; describe rack fabrication techniques and welding sequences; and specify the NDE methods to be used. The applicant should provide this information in the Technical Report and summarize it in the FSAR.

09.01.02-6

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10 CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. SRP Sections 9.1.2 and DSRS Sections 3.8.4 Appendix D describe the specific SRP acceptance criteria for the review of the fuel racks to meet the requirements of the Commission's regulations identified above. DSRS 3.8.4 specifically indicates that freestanding storage racks are subject to sliding, uplift, and impact between racks and with the pool walls.

The staff reviewed FSAR Tier 2, Section 9.1.2, and TR-0816-49833-P and did not find any technical specification or other formal restriction that requires all fuel racks to be in place when FAs are in any of the racks. To ensure that the fuel storage racks are not installed or configured in an unanalyzed condition, the staff requests the applicant describe whether any such restriction exists or address the condition of overturning and sliding stability, and seismic/structural design for fewer than the current design basis of a whole pool set of racks.

09.01.02-7

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10 CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. SRP Sections 9.1.2 and DSRS Sections 3.8.4 Appendix D describe the specific SRP acceptance criteria for the review of the fuel racks to meet the requirements of the Commission's regulations identified above.

The staff reviewed TR-0816-49833-P and identified the following inconsistencies that should be corrected.

- a. In the 2<sup>nd</sup> paragraph on page 13 of TR-0816-49833-P, the staff requests the applicant correct the reference to Figure 3-67. Staff believes the correct reference is Table 3-67.
- b. On Page 37 of TR-0816-49833-P, Figure 3-19 represents the spectral ratio for TH1 X direction. However, the label indicates the Y direction. The staff requests the applicant correct this inconsistency for Figure 3-19 and Figure 3-29 for the TH1 Z direction.
- c. On Page 172 of TR-0816-49833-P, there is an asterisk next to the ultimate stress for the stainless steel material at a temperature of 212 degrees F with no explanation or footnote for the asterisk. The staff requests the applicant provide this information.

09.01.02-8

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10 CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. SRP Sections 9.1.2 and DSRS Sections 3.8.4 Appendix D describe the specific SRP acceptance criteria for the review of the fuel racks to meet the requirements of the Commission's regulations identified above.

To fully understand the configuration and design of the fuel racks and FAs, additional details and dimensions of the fuel racks should be provided. These details should identify all of the structural members and connections (e.g., welds) for the various elements, including the poison plates, along with dimensions, sizes, material thicknesses, and weld types/sizes. Figures 1-1 and 1-2 provide some of this information, but the additional details described are needed.

09.01.02-9

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10 CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. SRP Sections 9.1.2 and DSRS Sections 3.8.4 Appendix D describe the specific SRP acceptance criteria for the review of the fuel racks to meet the requirements of the Commission's regulations identified above. DSRS 3.8.4 specifically states that the review of the design and analysis procedures used for seismic Category I structures focuses on the extent of compliance with American National Standards Institute (ANSI)/American Institute of Steel Construction (AISC) N690-1994 including Supplement 2 (2004) for steel structures. The use of more recent codes and standards is reviewed for adequacy on a case-by case basis.

On Page 1 of TR-0816-49833-P, the applicant states, "The structural integrity of the fuel storage racks are evaluated to criteria specified in ASME Code Section III, Division I, Subsection NF (Reference 12) and AISC 9<sup>th</sup> Edition (Reference 16)." Since only AISC N690-1994 including Supplement 2 (2004) has been accepted by the staff in DSRS 3.8.4, the applicant is requested to explain why Reference 16 (AISC, "Manual of Steel Construction," 9<sup>th</sup> edition) was used and to identify all cases where it was used.

09.01.02-10

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10 CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. SRP Sections 9.1.2 and DSRS Sections 3.8.4 Appendix D describe the specific SRP acceptance criteria for the review of the fuel racks to meet the requirements of the Commission's regulations identified above.

On page 146, in Section 3.1.4.10, the applicant describes the application of gravity load to all the parts in the model except the concrete pool but does not discuss the effects of buoyancy. The applicant should provide where in the report the effects of buoyancy are described or add to the report an explanation of how the effects of buoyancy were considered.

09.01.02-11

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10 CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. SRP Sections 9.1.2 and DSRS Sections 3.8.4 Appendix D describe the specific SRP acceptance criteria for the review of the fuel racks to meet the requirements of the Commission's regulations identified above. DSRS 3.8.4, Appendix D, I.4 specifically states, "The temperature gradient across the rack structure that results from the differential heating effect between full and empty tube(s) should be indicated and incorporated in the design of the rack structure."

The staff review of FSAR Section 9.1.2 and TR-0816-49833 did not identify that the differential heating effect between full and empty tube(s) was incorporated in the design of the rack structure. The applicant

should identify where this evaluation is described in the technical report, or justify why it is not incorporated in the design of the rack structure.

09.01.02-12

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10 CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. SRP Sections 9.1.2 and DSRS Sections 3.8.4 Appendix D describe the specific SRP acceptance criteria for the review of the fuel racks to meet the requirements of the Commission's regulations identified above.

In FSAR Section 9.1.2.2.2, "Fuel Storage Rack Design," the applicant states, Based on the travel limitations of the fuel handling machine, the fuel storage racks can safely store 1,404 fuel assemblies vertically in the SFP; however, only 1,393 fuel storage locations are considered accessible due to the possible difficulty reaching the storage locations closest to the weir wall." On Page 2 of TR-0816-49833-P, the applicant states "The fuel storage racks can safely store at least 1404 FAs vertically in the SFP, factoring in the maximum reach of the fuel handling machine path. Because of the reach of the fuel handling machine, not all fuel cells can be safely reached. Therefore, a maximum of 1404 FAs is used in the analysis."

The applicant should confirm whether the maximum number of fuel assemblies that are permitted to be stored within the racks is 1,404 or 1,393. The applicant should also confirm that the whole pool analysis model uses the same fill arrangement.

Further, the applicant should identify where the FSAR states that fuel assemblies are only permitted to be stored within the red line region as shown in Figure 9.1.2-1 or provide a statement in the FSAR to identify this restriction. The applicant should explain whether there is a technical specification requirement or other means of ensuring that the maximum permissible fuel assembly configuration is never exceeded.

09.01.02-13

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10 CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. SRP Sections 9.1.2 and DSRS Sections 3.8.4 Appendix D describe the specific SRP acceptance criteria for the review of the fuel racks to meet the requirements of the Commission's regulations identified above.

In Section 3.1.4.1 (page 130) of TR-0816-49833-P, the methodology for modeling the water in the pool is described. The applicant describes the use of the Arbitrary- Lagrangian-Eulerian (ALE) capability in LS-DYNA which considers the hydrodynamic coupling effects between the rack and the fluid within the spent fuel pool (SFP). The applicant is requested to summarize the validation of the LS-DYNA computer code, including the use of the ALE methodology in the code. The description of the validation for the ALE methodology should include specific solutions to test problems applicable to the modeling of the water in the SFP. The results of these test problems in LS-DYNA should be compared to solutions obtained from classical solutions, other codes or experimental results.