NuScaleDCRaisPEm Resource

From: Cranston, Gregory
Sent: Saturday, August 05, 2017 2:51 PM
To: RAI@nuscalepower.com
Cc: NuScaleDCRaisPEm Resource; Lee, Samuel; Chowdhury, Prosanta; Jackson, Diane; Travis, Boyce; Tabatabai, Omid
Subject: RE: Request for Additional Information No. 152, RAI 9047 (6.2.5)
Attachments: Request for Additional Information No. 152 (eRAI No. 9047).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.

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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Created By: Gregory.Cranston@nrc.gov

Recipients:
"NuScaleDCRaisPEm Resource" <NuScaleDCRaisPEm.Resource@nrc.gov>
Tracking Status: None
"Lee, Samuel" <Samuel.Lee@nrc.gov>
Tracking Status: None
"Chowdhury, Prosanta" <Prosanta.Chowdhury@nrc.gov>
Tracking Status: None
"Jackson, Diane" <Diane.Jackson@nrc.gov>
Tracking Status: None
"Travis, Boyce" <Boyce.Travis@nrc.gov>
Tracking Status: None
"Tabatabai, Omid" <Omid.Tabatabai-Yazdi@nrc.gov>
Tracking Status: None
"RAI@nuscalepower.com" <RAI@nuscalepower.com>
Tracking Status: None

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Request for Additional Information No. 152 (eRAI No. 9047)

Issue Date: 08/05/2017
Application Title: NuScale Standard Design Certification - 52-048
Operating Company: NuScale Power, LLC
Docket No. 52-048
Review Section: 06.02.05 - Combustible Gas Control in Containment
Application Section: 6.2.5 / TR-0716-50424

QUESTIONS

06.02.05-3

10 CFR Part 50.44, “Combustible gas control for nuclear power reactors” subpart (c), “Requirements for Future Water-Cooled Reactor Applicants and Licensees,” requires in part that all equipment required to establish safe shutdown and ensure containment function must have the capability to withstand a hydrogen burn and detonation resulting from at least the hydrogen generated following a fuel clad-coolant reaction involving 100 percent of the fuel cladding, unless such detonations can be shown to be unlikely to occur. Following such a hydrogen burn, this equipment must continue to perform its function during design-basis and significant beyond design basis accidents.

For the NuScale design, this includes the containment vessel. TR-0716-50424, “Combustible Gas Control,” provides the demonstration that the NuScale design has the ability to establish and maintain safe shutdown and maintain containment structural integrity during and after exposure to the environmental conditions created by the burning of hydrogen within the CNV.

In TR-0716-50424, it is stated that the TNT equivalence method is used to calculate the pulse period, and the deflagration-to-detonation transition (DDT) pressure is used as the limiting combustion load. In the calculations performed in TR-0716-50424, the DDT pressure appears to be limiting. In the TNT-equivalence calculation performed as part of TR-0716-50424, a yield efficiency factor (alpha) of 0.03 was used, based on an industry reference “Guidelines for Evaluating the Effects of Vapor Cloud Explosions Using a TNT Equivalency Method”, which is available in ADAMS under accession number ML14224A361. In that source, a value of 0.05 (rather than the 0.03 used by NuScale) is recommended for hydrogen, but that this factor is based on a number of factors including layout. Both the source and NUREG-1805 note that level of confinement tends to increase the yield efficiency factor.

Additionally, the scaled distance parameter Z, which is used to determine the effective pulse impacts from the TNT-equivalent detonation, is based on the full containment vessel radius. The justification provided states that the “resulting pulse period is insensitive to this parameter over the majority of distances applicable for the CNV geometry”; while this may be valid for the pulse period, it is not valid for the pressure cited in Table 3-8 of the report. Given that such a distance is not feasible within the containment for most detonation/impact location pairs, this choice appears to be non-conservative. Further, the parameters calculated from the use of Z are based on a TNT explosion in free air at sea level. The impact of the post-accident containment conditions as compared to free air on the calculated parameters is not assessed in the report.

Based on the above discussion, the values used in the TNT-equivalence calculation do not appear representative of the conditions that would exist inside the containment during a severe accident, and the discrepancies between the existing calculation and a more representative one would result in substantial differences in the resultant pressure parameters. NRC staff requests that NuScale justify the use of 0.03 as the yield efficiency factor for the TNT-equivalence calculation and justify the use of the containment radius as the effective distance for all parameters from the TNT-equivalent detonation, given the existing containment and in-containment SSCs configuration and conditions related to hydrogen generation. Another alternative could involve revising the calculation to include more representative parameters for the yield efficiency factor and scaled distance parameter, and re-evaluating the TNT-equivalent pressure and associated parameters, or providing another means to address the potential for a hydrogen detonation in the containment to meet the requirements associated with 50.44(c).