NuScaleDCRaisPEm Resource

From:	Cranston, Gregory
Sent:	Friday, October 13, 2017 5:06 PM
To:	RAI@nuscalepower.com
Cc:	NuScaleDCRaisPEm Resource; Lee, Samuel; Hayes, Michelle; Schaperow, Jason; Franovich, Rani
Subject:	Request for Additional Information No. 259 RAI No. 9138 (19)
Attachments:	Request for Additional Information No. 259 (eRAI No. 9138).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

Hearing Identifier: NuScale_SMR_DC_RAI_Public
Email Number: 284

Mail Envelope Properties (5bd1401d0ed74535aabe48f23371c569)

Subject: Request for Additional Information No. 259 RAI No. 9138 (19)
Sent Date: 10/13/2017 5:06:28 PM
Received Date: 10/13/2017 5:06:31 PM
From: Cranston, Gregory

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
"Hayes, Michelle" <Michelle.Hayes@nrc.gov>
Tracking Status: None
"Schaperow, Jason" <Jason.Schaperow@nrc.gov>
Tracking Status: None
"Franovich, Rani" <Rani.Franovich@nrc.gov>
Tracking Status: None
"RAI@nuscalepower.com" <RAI@nuscalepower.com>
Tracking Status: None

Post Office: R4PWMSMRS03.nrc.gov

Files	**Size**	**Date & Time**
MESSAGE	556	10/13/2017 5:06:31 PM
Request for Additional Information No. 259 (eRAI No. 9138).pdf	92464	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Request for Additional Information No. 259 (eRAI No. 9138)

Issue Date: 10/13/2017
Application Title: NuScale Standard Design Certification - 52-048
Operating Company: NuScale Power, LLC
Docket No. 52-048
Review Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation
Application Section: 19

QUESTIONS

19-33

10 CFR 52.47(a)(23) states that a design certification (DC) application must contain a final safety analysis report (FSAR) that includes a description and analysis of design features for the prevention and mitigation of severe accidents (e.g., challenges to containment integrity caused by core-concrete interaction, steam explosion, high-pressure melt ejection, hydrogen combustion, and containment bypass). For staff to make a finding that the applicant has performed an adequate evaluation of the risk from severe accidents in accordance with Standard Review Plan (SRP) 19.0, the applicant is requested to provide the additional information requested below.

a. FSAR Section 19.2.3.3.5 describes a thermodynamic analysis of the energy release from a hypothetical in-vessel steam explosion (i.e., within the reactor pressure vessel (RPV)) which concludes that the energy released is insufficient to challenge RPV integrity. The staff requests additional information to understand how the analysis relates to past Nuclear Regulatory Commission and industry studies of in-vessel steam explosion including “An Assessment of Steam-Explosion-Induced Containment Failure. Part 1: Probabilistic Aspects,” Theophanous, T. G., Najafi B., and Rumble, E., *Nuclear Science and Engineering*: 97, 259-281 (1987) and “A Reassessment of the Potential for an Alpha-Mode Containment Failure and a Review of the Current Understanding of Broader Fuel-Coolant Interaction Issues; Second Steam Explosion Review Group Workshop,” NUREG-1524, August 1996. For example, what did the applicant assume for the conversion ratio versus thermal energy in the mixed melt? What did the applicant assume for the net energy in the head after dissipation in upper internals versus slug energy? Please provide any benchmarking of the applicant’s analysis against past studies in terms of energy release and mechanical loads, considering the similarities in phenomenology and the design differences (NuScale vs. large light-water reactors)?

b. For in-vessel steam explosion, the applicant’s analysis addressed different initial reactor coolant system (RCS) hole sizes and emergency core cooling system (ECCS) failure modes by using as input the MELCOR predictions for sequences with different initial RCS hole sizes and ECCS failure modes. However, the NRC staff could not find where the applicant’s analysis addressed uncertainties in the modeling of physical phenomena in its MELCOR simulations, such as uncertainties in in-vessel melt progression modeling (e.g., modeling of core heat-up, collapse, and formation of molten pool). Such uncertainties have the potential to result in a different energy of corium relocating to the water in the RPV lower plenum. An example of consideration of such uncertainties is given in “State-of-the-Art Reactor Consequence Analyses (SOARCA) Project: Sequoyah Integrated Deterministic and Uncertainty Analyses,” Draft Report, April 2016 (ADAMS Accession Number ML17156A255). The staff requests additional information to understand how the applicant’s analysis addressed uncertainties in the modeling of physical phenomena.

c. FSAR Section 19.2.3.3.5 states that an ex-vessel steam explosion (i.e., within the containment vessel (CNV)) is judged to be physically unrealistic based on the size of the NuScale core, the physical dimensions of the CNV, the proximity between the RPV and CNV, the associated potential drop height for fuel between the two, and thermal-hydraulic conditions within the CNV in the postulated condition that the RPV were breached. The applicant is requested to provide quantitative justification for this judgment, including addressing the potential for an ex-vessel steam explosion to cause the CNV to move sufficiently to induce a CNV structural failure. For example, AP1000 calculations in NUREG/CR-6849 indicated the potential for large impulse loads on the cavity and the RPV (and subsequently the containment penetrations). The phenomena occurring inside the NuScale CNV with a high water level appears to be similar to the AP1000 analysis.